IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicants: Suekane et al.

Title: Magnetic Recording Medium

Serial No.:   09/895,679   Filing Date: 6/29/01

Examiner: H. Rickman   Art Unit: 1773

Docket No.:   AK2-C1

Director of the United States Patent and Trademark Office
P.O. Box 1450
Alexandria. VA 22313-1450

DECLARATION OF DR. CHRISTOPHER H. BAJOREK

I, Dr. Christopher H. Bajorek, declare:

1.   I am the same Christopher H. Bajorek who submitted declarations earlier

during prosecution of the above-mentioned patent application.

2.   I have read and understand U.S. Patent 6,280,813, issued to Carey. At

column 6, lines 21-28, Carey states:

> For an antiparallel alignment of the ferromagnetic films to be realized requires
> that H_{ex2} exceed the coercive field required to reverse the bottom ferromagnetic
> film (H_{c2}). H_{c2} is the coercive field of the bottom film, assuming no exchange
> interaction with the top ferromagnetic film. Thus, the magnetic properties and
> thickness of the bottom film, as well as the AF-coupling film, must be designed to
> maintain $H_{ex2} > H_{c2}$.

This passage from Carey does not contradict my earlier declaration stating that

antiferromagnetic coupling is inherent for a magnetic medium comprising a bottom Co

magnetic alloy, a Ru intermediate layer from 3 to 10 angstroms thick on the bottom Co

magnetic alloy, and a top Co magnetic alloy on top of the Ru intermediate layer.

9/9/03 Declration

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3.   In Carey, the coercive force H_{c2} is the magnetic field required to flip the direction of magnetization for bottom film 14. For example, coercive force H_{c2} is the magnetic field required to flip the direction of arrow 24 (Carey Fig. 1).

4. H_{ex2} is the antiferromagnetic field caused by the presence of top magnetic layer 12 and Ru layer 16 exerted on bottom magnetic layer 14. In other words, H_{ex2} is the field that shows antiferromagnetic coupling.

5.   At col. 6, line 28, Carey states that if one wants the antiferromagnetic coupling to flip the magnetization direction of bottom magnetic layer 14, H_{ex2} should be greater than H_{c2}.[1] In other words, the antiferromagnetic field should be greater than the field needed to flip the magnetization direction of bottom magnetic layer 14.

6.   This does not mean that one needs $H_{ex2} > H_{c2}$ for there to be antiferromagnetic coupling. (The antiferromagnetic coupling exists merely due to the fact that H_{ex2} is greater than zero and is in a direction opposite to the magnetization direction of upper magnetic layer 12, which in turn is the result of the magnitude of J_{ex} not being zero.[2]) Rather, Carey is saying that if one wants to use the antiferromagnetic coupling to flip the magnetization direction of layer 14, it should be greater than the coercivity of layer 14.

7.   By way of analogy, assume that a locomotive is coupled to a set of 20 railroad cars, but the locomotive engine is weak. Therefore, the locomotive, by itself, is

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[1] Carey impliedly assumes that exchange field H_{ex2} would be the only force acting on bottom magnetic film 14 that tends to reverse the magnetization direction of film 14. Carey actually omits mentioning several other forces acting on film 14, but for sake of argument, my discussion assumes that Carey is accurate and precise.

[2] J_{ex} must also have a certain polarity for antiferromagnetic coupling to exist. This polarity is inherent if the Ru layer is from 3 to less than 10 angstroms.

unable to pull the railroad cars. (The railroad cars will not move unless the force exerted by the locomotive exceeds whatever friction keeps the railroad cars in place.) Nonetheless, the locomotive is still coupled to the railroad cars, regardless of whether the force exerted by the locomotive, by itself, can move the cars.

8.   At col. 6, line 17, Carey states that $H_{ex2}=J_{ex}/M_2t_2$. This also does not contradict the fact that antiferromagnetic coupling is inherent in the structure disclosed in the present application. As stated above, H_{ex2} is the exchange field caused by the antiferromagnetic coupling. Carey states that J_{ex} is the antiferromagnetic interface exchange energy density across the Ru spacer layer, M_2 is the magnetization of bottom magnetic layer 14 and t_2 is the thickness of bottom magnetic layer 14. For a magnetic recording medium comprising a bottom Co magnetic alloy layer, an intermediate Ru layer having a thickness from 3 to 10 angstroms, and a top Co magnetic alloy layer, a non zero value of the necessary polarity for J_{ex} is inherent. While Carey states that M_2 and t_2 can be used to control the precise magnitude of the exchange field H_{ex2}, they do not control whether the exchange field exists, because the exchange field is inherent. In other words, even if Carey's equation is true, it does not in any way contradict the inherency of antiferromagnetic coupling as set forth in my previous declarations.

9.   I have also read and understand Parkin, "Systematic Variation of the Strength and Oscillation Period of Indirect Magnetic Exchange Coupling through the 3d, 4d, and 5d Transition Metals". During the above-mentioned phone conference, the Examiner directed our attention to an equation toward the bottom of the right column of page 3598 that states:
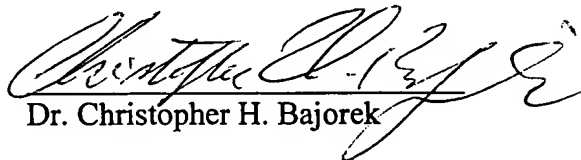
$$J_{AF}=H_SMt_F/2\alpha$$

This is essentially the same equation as that given by Carey. J_{AF} corresponds to Carey's term J_{ex}, H_S corresponds to H_{ex2}, and Mt_F corresponds to M_2t_2. Parkin says that α is a value between 1 and 2. For a structure comprising only one pair of magnetic layers separated by a Ru intermediate layer, α equals 1. See Parkin page 3598.

10.   For the case in which there is only one pair of magnetic layers, the above-quoted equations in Parkin and Carey are the same. (The factor 2 in the Parkin denominator is present because he assumes that t_F is the thickness of all of the films, and Carey assumes that t_2 is the thickness of only the bottom film.)
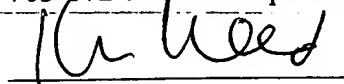
11.   I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements are made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

Respectfully submitted,

Dr. Christopher H. Bajorek

_9/9/03_
Date

Pursuant to rule 37 CFR 1.8, Applicant's attorney hereby certifies that this document is being sent by facsimile to the United States Patent and Trademark Office, FAX number 703-872-9719 on September 9, 2003.

_____   September 9, 2003
Signature   Date